Nutrient Management Summary

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A farm nutrient management plan is a strategy for obtaining the maximum return from on and off-farm fertilizer resources in a manner that protects the quality of nearby water resources.

Nutrient Management Mechanics

- Measure current levels of soil fertility
- Determine crop nutrient needs
- Account for on-farm nutrient resources
  - Manure applications
  - Legumes in crop rotation
  - Residual soil nitrate
- Adjust commercial fertilizer application rates

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Basic Components

- Soil test reports
- Manure inventory
- Nutrient crediting
  - Manure, legumes, other (biosolids, whey, etc.)
- Manure spreading plan
- Soil conservation plan

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Soil Testing

- Soil Test Reports:
  - Within last 4 years from Certified Lab
  - Minimum 1 sample per 5 acres
- Standard lab test results include:
  - soil pH, organic matter (%), P (ppm), K (ppm)
- *N recommendations based on crop grown, crop need, and N credits*
- Soil testing key for managing P, K, and pH

On-Farm Nutrient Sources: Manure

- Inventory of species, growth stage, size, production level for total manure production
- Available nutrient content
  - Book values
  - Laboratory analysis
- Manure application rate & uniform application

Crop Removal Compared to Manure Nutrient Content

- Corn, soybean & alfalfa utilize approx. 3X more N than P
- Manure supplies N & P_2O_5 at approximately a 1:1 ratio
- Soil test P levels increase over time if applying manure to meet crop N need
- Applying rotational P need rather than single year is permitted (planning for perennial hay crop)

	N	P_2O_5	K_2O
	lb/a/yr		
Corn (160 bu/a)	160*	60	45
Corn silage (23 ton/a)	160*	85	135
Soybean (40 bu/a)	125	35	40
Alfalfa (5 ton/a)	250	65	250

First-year *available* nutrient content averages.[1]

SPECIES	N	P_2O_5	K_2O
	lbs/ton		
Dairy (>20% DM)	2 (3/3)[2]	3	6
Dairy (11-20% DM)	2 (2/3)[2]	3	5
Beef	3 (4/5)	6	10
Swine	7 (9/12)	10	8
Chicken	24 (27/29)	35	26
Turkey	26 (28/31)	35	25

[1] *Source: Wisconsin soil test labs.*
[2] *Values in parenthesis for incorporated manure: (1 hr. - 3 days / < 1 hr.).*

Visual Corn N Assessment

Corn color is an indicator of N deficiency (yellow corn) but is a poor indicator of N adequacy

N is mobile in plants, deficiency symptoms show on older leaves

But how green is green enough?

UW ***Corn & Wheat Nitrogen*** Recommendations

- Maximum Return to N (MRTN)
  - Cost of N
  - Price of corn
- Soil texture & yield potential, Organic Matter, Irrigation
- Cropping systems
  - Corn after soybeans, small grains
  - Corn after corn, forage legumes, green manures

CORN YIELD GOAL NO LONGER CONSIDERED

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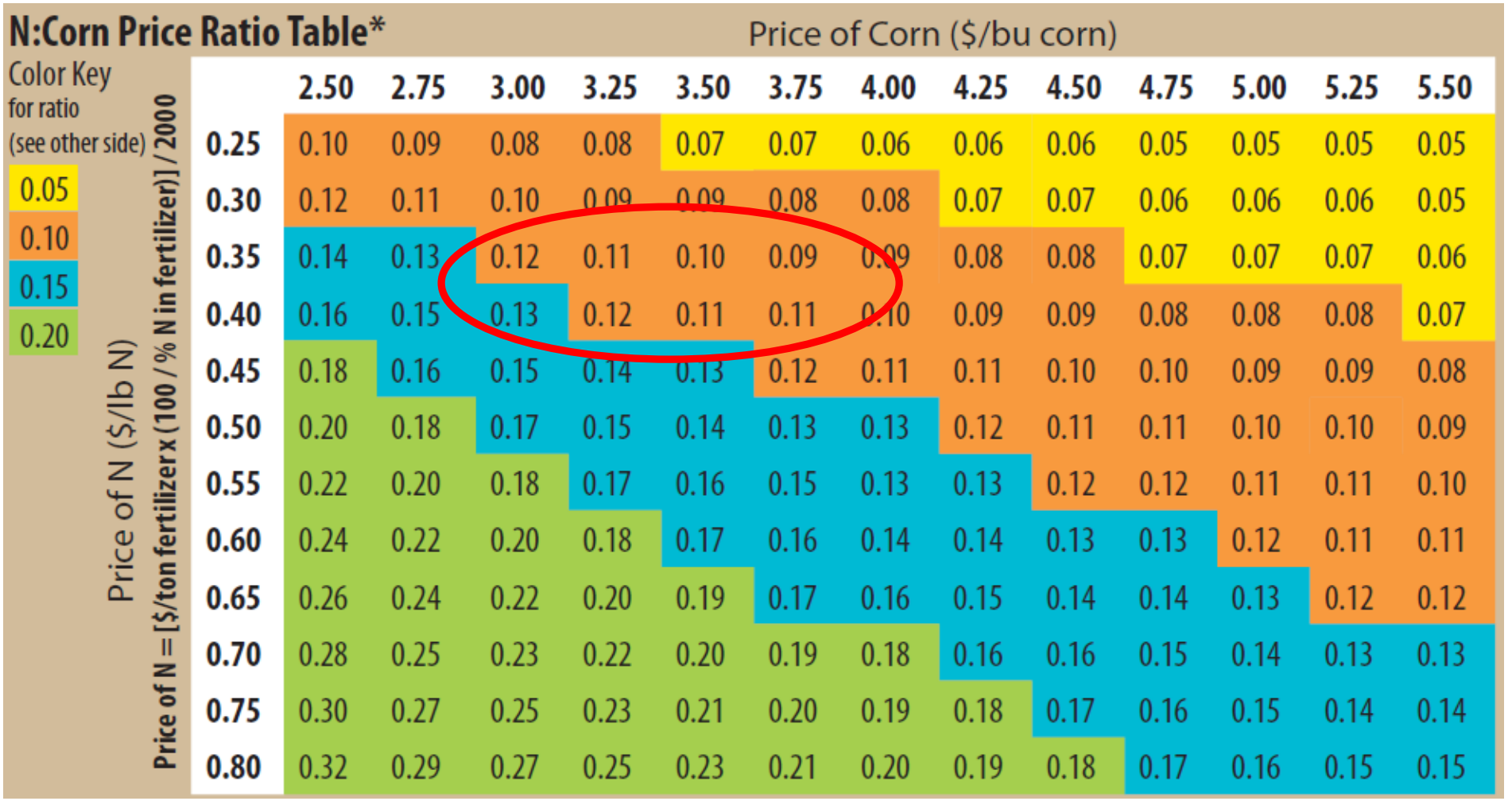
Nitrogen: Corn Price Ratios



N:Corn Price Ratio Table*

Color Key for ratio (see other side)

0.05
0.10
0.15
0.20

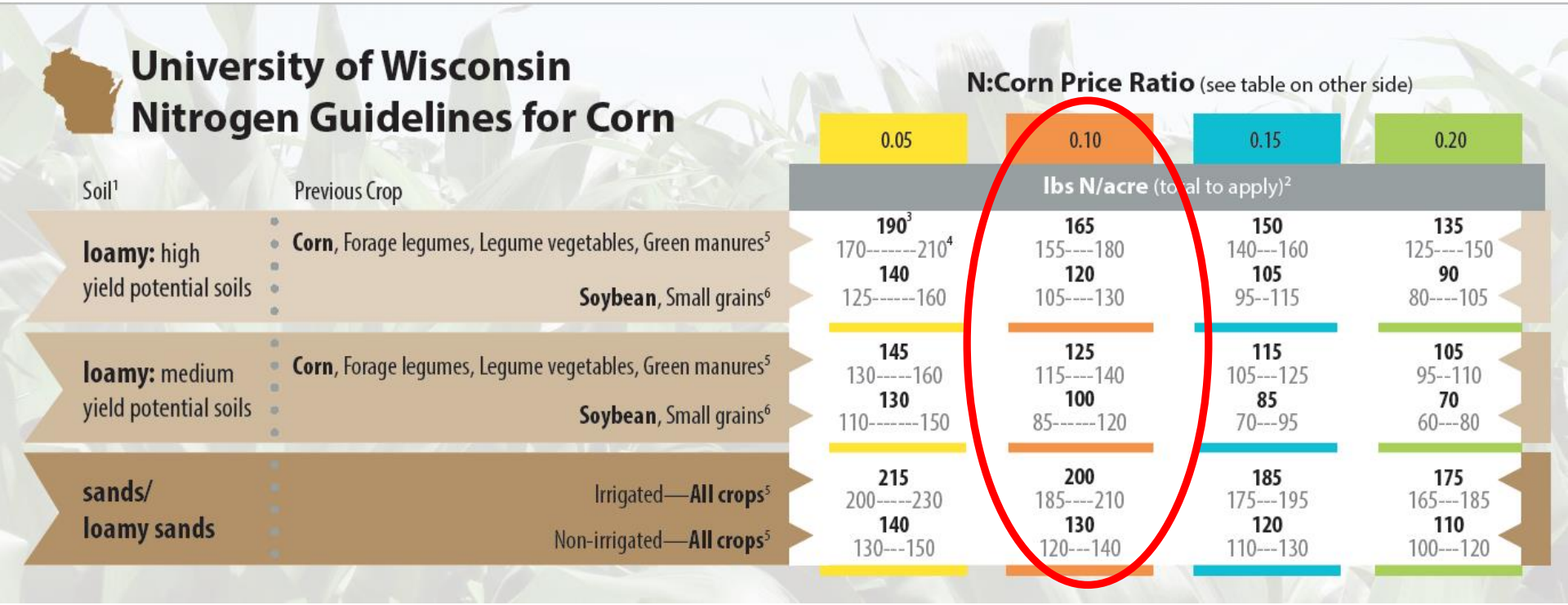
Price of N ($/lb N)

Price of N = [$/ton fertilizer x (100 / % N in fertilizer)] / 2000

Price of Corn ($/bu corn)

	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.25	5.50
0.25	0.10	0.09	0.08	0.08	0.07	0.07	0.06	0.06	0.06	0.05	0.05	0.05	0.05
0.30	0.12	0.11	0.10	0.09	0.09	0.08	0.08	0.07	0.07	0.06	0.06	0.06	0.05
0.35	0.14	0.13	0.12	0.11	0.10	0.09	0.09	0.08	0.08	0.07	0.07	0.07	0.06
0.40	0.16	0.15	0.13	0.12	0.11	0.11	0.10	0.09	0.09	0.08	0.08	0.08	0.07
0.45	0.18	0.16	0.15	0.14	0.13	0.12	0.11	0.11	0.10	0.10	0.09	0.09	0.08
0.50	0.20	0.18	0.17	0.15	0.14	0.13	0.13	0.12	0.11	0.11	0.10	0.10	0.09
0.55	0.22	0.20	0.18	0.17	0.16	0.15	0.13	0.13	0.12	0.12	0.11	0.11	0.10
0.60	0.24	0.22	0.20	0.18	0.17	0.16	0.14	0.14	0.13	0.13	0.12	0.11	0.11
0.65	0.26	0.24	0.22	0.20	0.19	0.17	0.16	0.15	0.14	0.14	0.13	0.12	0.12
0.70	0.28	0.25	0.23	0.22	0.20	0.19	0.18	0.16	0.16	0.15	0.14	0.13	0.13
0.75	0.30	0.27	0.25	0.23	0.21	0.20	0.19	0.18	0.17	0.16	0.15	0.14	0.14
0.80	0.32	0.29	0.27	0.25	0.23	0.21	0.20	0.19	0.18	0.17	0.16	0.15	0.15

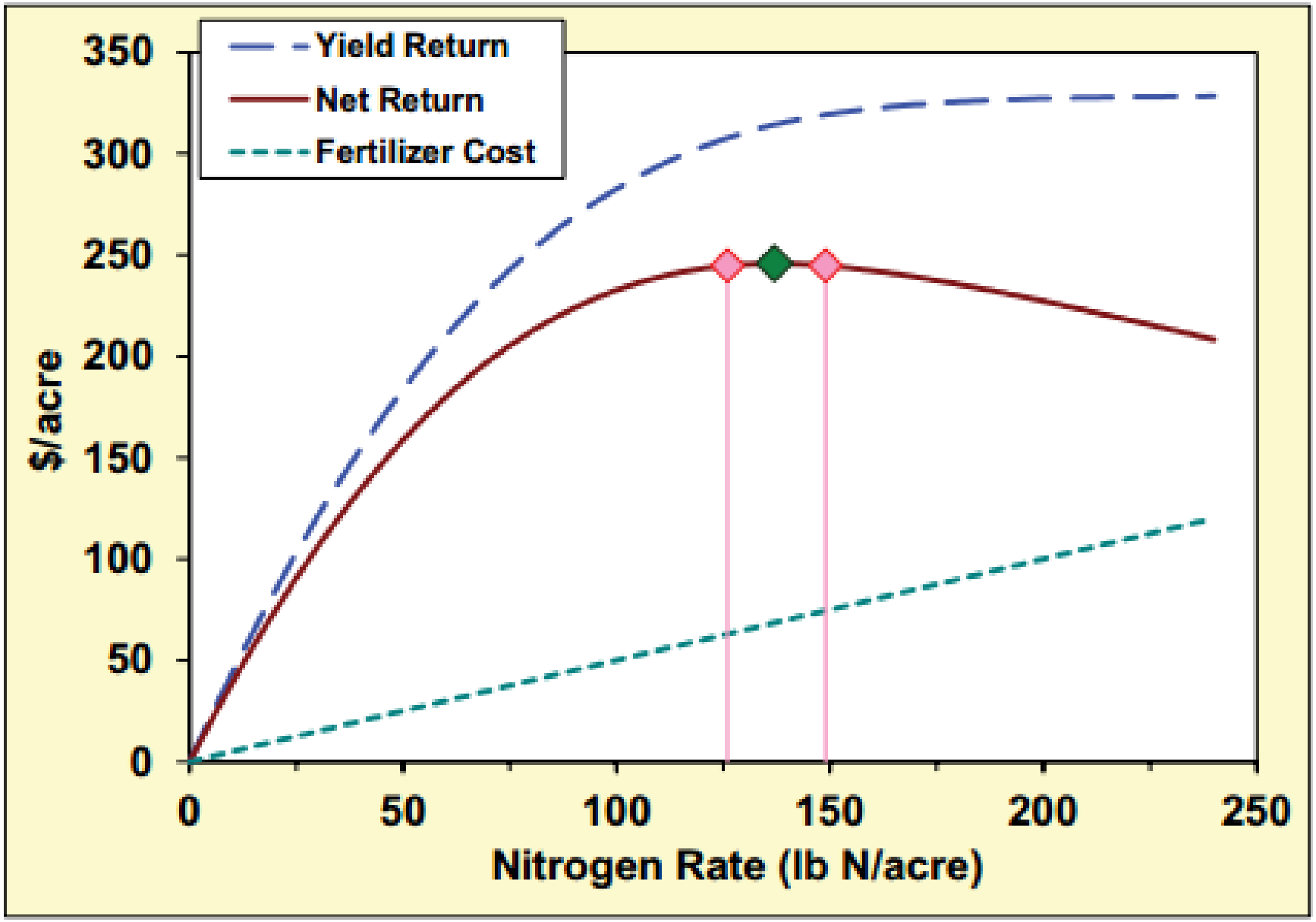
Price Adjusted N Guidelines for Corn



University of Wisconsin Nitrogen Guidelines for Corn

N:Corn Price Ratio (see table on other side)

Soil[1]	Previous Crop	0.05	0.10	0.15	0.20
		lbs N/acre (total to apply)[2]			
loamy: high yield potential soils	**Corn**, Forage legumes, Legume vegetables, Green manures[5]	**190**[3] 170-------210[4]	**165** 155----180	**150** 140---160	**135** 125----150
	Soybean, Small grains[6]	**140** 125------160	**120** 105----130	**105** 95--115	**90** 80----105
loamy: medium yield potential soils	**Corn**, Forage legumes, Legume vegetables, Green manures[5]	**145** 130-----160	**125** 115----140	**115** 105---125	**105** 95--110
	Soybean, Small grains[6]	**130** 110-------150	**100** 85------120	**85** 70---95	**70** 60---80
sands/ loamy sands	Irrigated—**All crops**[5]	**215** 200-----230	**200** 185----210	**185** 175---195	**175** 165---185
	Non-irrigated—**All crops**[5]	**140** 130---150	**130** 120---140	**120** 110---130	**110** 100---120



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N Recommendations For Most Situations

- Soybeans 0 lb/a
- Alfalfa 0 lb/a
  - Alfalfa Seeding Year 0-30 lb/a
- Oat/peas 20-60 lb/a
- Grass Hay 100-160 lb/a
- Pasture 0-160 lb/a
  - Depends greatly on % legume / clover

On-Farm Sources: Legumes

- N Credits for Alfalfa Depend on:
  - Soil texture (sands vs. others)
  - Harvest management
  - Stand density
- Does NOT Depend on:
  - Time of killing (spring vs. fall)
  - Method of killing (tillage vs. herbicide)
  - Tillage

1st Year N Credits for Alfalfa

Alfalfa Stand Density	Medium or Fine Textured Soils		Sandy Soils	
	> 8 inches regrowth	< 8 inches regrowth	> 8 inches regrowth	< 8 inches regrowth
	NITROGEN CREDIT			
	lbs N/acre			
Good >70%	190	150	140	100
Fair 30-70%	160	120	110	70
Poor <30%	130	90	80	40

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Nitrogen Credits

- 2nd Year N credits Alfalfa up to 50 lbs (not on poor stands or on sands)
- Red Clover
    - *~80% of alfalfa credit*
- Soybean ~20 lbs N/a
    - *no credit on sands or loamy sands*
    - *NOTE: soybean N credit no longer exists in the revised, price adjusted (MRTN), guidelines for corn N*

How does N become available?

(Soil Temp. > 50 degrees F)

Manure
Legume
Commercial N

Plant available N

*Plants utilize inorganic N, cannot utilize organic N

Nitrogen Availability is Temperature and Moisture Dependent

- Manure applied in the fall retains a full nitrogen credit the following spring.
- Legume hay killed in the fall retains the same credit as hay killed in the spring.
- A cool spring may delay release of nitrogen and cause an early-season nitrogen deficiency.

Soil Tests To Measure Nitrogen

Preplant Soil Nitrate Test

- Soil sampled preplant in one foot increments to a depth of two feet
- Measures nitrate carryover from previous fall (but not N credits)
- Environmental conditions can affect interpretation of management
- Not effective for N recommendation next season
- *Experimental:* test in fall to prioritize fields for cover crops

Soil Tests To Measure Nitrogen

Pre-sidedress Soil Nitrate Test

- Sidedress / topdress = application after crop is planted
- Soil sampled to a depth of one foot when corn plants are 6-12 inches tall.
- Useful to confirm nitrogen credits.
- Not applicable on sands, loamy sands.

Pre-sidedress Soil Nitrate Test

- Estimates N availability from organic sources
  - Measures N credits from manure
  - Useful when manure & legume history is unknown
- Partial accounting for carry-over nitrate
- Short sampling & analysis time
- Sidedress N if needed

Nitrification Inhibitors

Nitrification inhibitors (NI) are chemicals that reduce the rate at which ammonium is converted to nitrate by killing or interfering with the metabolism of Nitrosomonas bacteria

- Commercially known as N-Serve and Instinct
- Effectiveness weather dependent
- N-Serve is oil based and may not mix well with liquid manure, whereas Instinct is water soluble and microencapsulated and may mix better

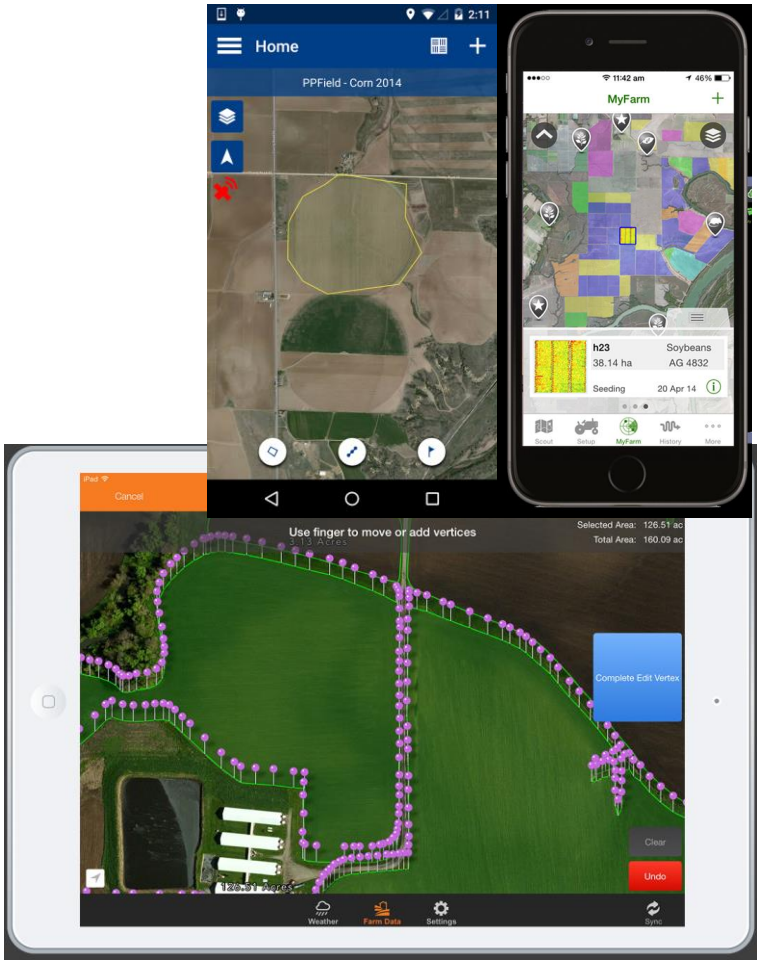
Anaerobic Digesters

- Benefits for renewable energy, cost of constructing manure storage, odor control, etc.
- Digesters utilize the organic matter in manure
- Misconception: digesters reduce nutrients
  - N, P & K transformed but amount coming out is same as amount going in
  - N form changes from organic to inorganic

Precision Ag

- Management of in-field variation
- Optimization of inputs
- Increase profit through reduced expenses

- Precision Apps on the market…
  - SST Software – Sirrus
  - AgDNA
  - Trimble Connected Farm
  - AgLeader – SMS Mobile

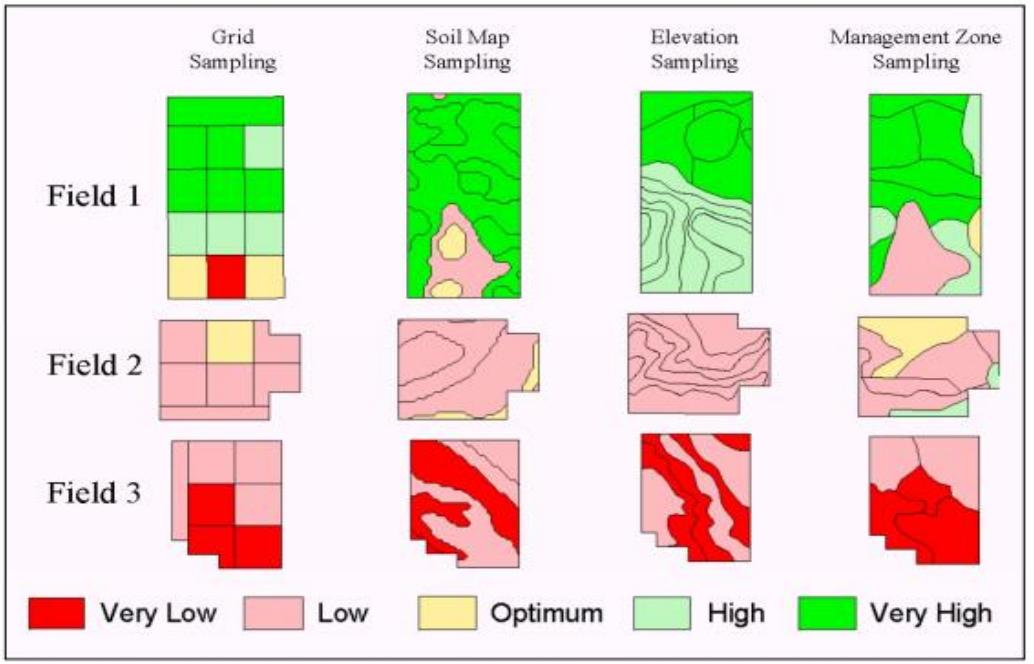


Grid / Zone soil sampling

- Precision mapping and application technology allows for grid soil sampling in 1 acre or smaller increments
- Zone sampling overlays multiple mapping layers such as topography, yields, soil name, etc.

Aforementioned Apps include soil sampling modes

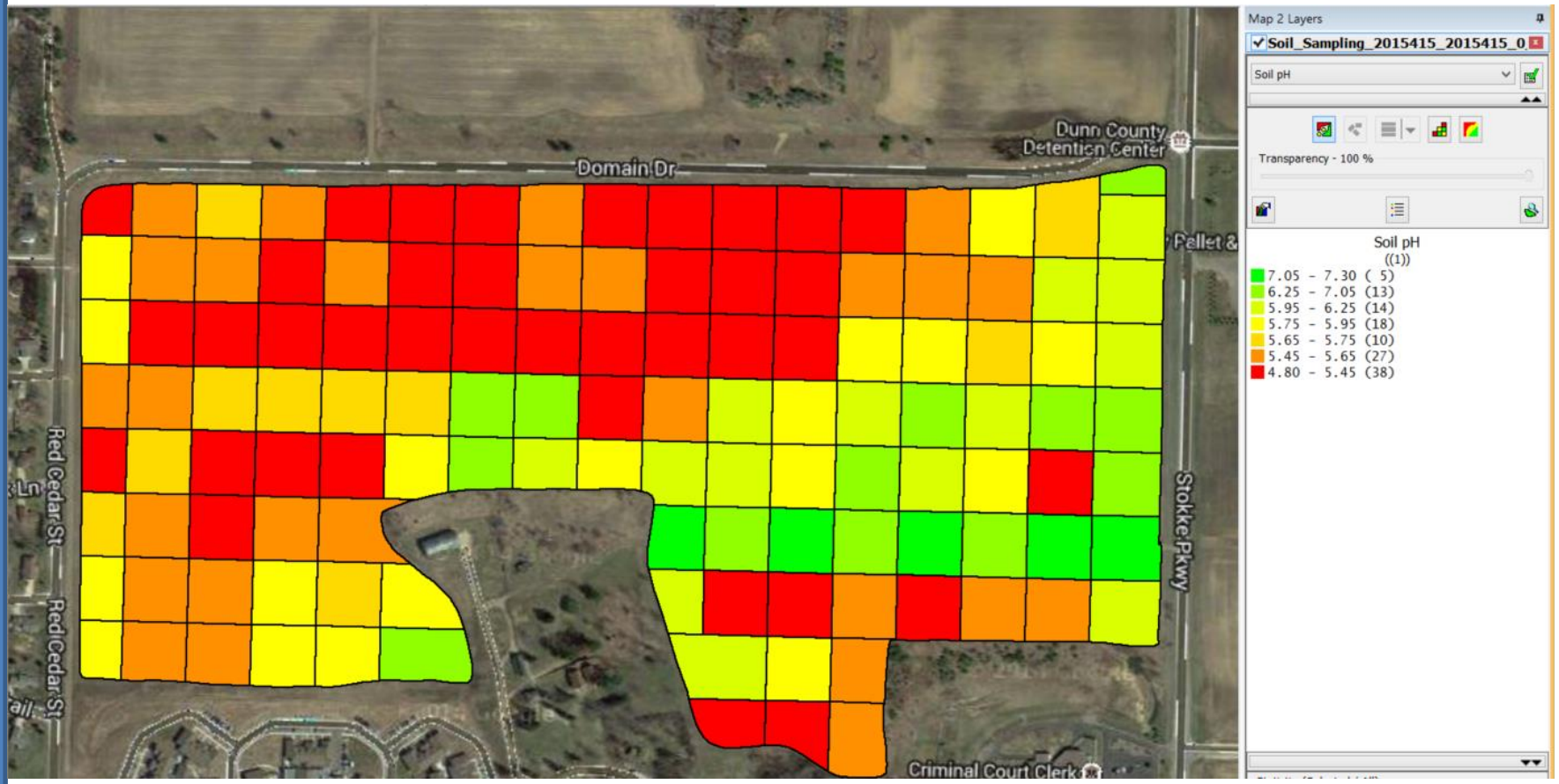
- Grid/Zone layout
- Barcode generation for sample identification
- Associate lab results and generate prescription maps



Dunn County Field Lime Example

- 1 ac grid soil sampling @ 120 ac
- 2 ton/ac applied in spring @ $26/ton = $6,240
- Soil sampling showed variation from 0 – 15 ton/ac
  - Not practical … assume 6 ton/ac max
- Aim for the middle @ 3 ton/ac additional application = $9,360 additional cost in the fall
- Variable rate came out to be an average rate of 1.57 ton/ac with some areas getting 3 ton/ac while others received 0 ton/ac
- Total applied 188.33 ton costing $4,897 ($4,463 dif.)
- Soil sampling in the spring should show less variation in soil pH across the field

Example Grid Soil Sampling Results - Soil pH



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Cover Crops

- Renewed interest
- More unknown than known
- Fall ‘16 near ideal for cover crop establishment
- Multiple potential benefits
  - Residue cover to reduce soil loss
  - Build soil organic matter
  - Soil microbe activity
  - Nutrient management

Growing season & planting date matter

Cover Crops & Nitrogen

- Legumes or legume mixes can supply N to next crop “Green Manure N Credit”
- Grasses and brassica’s can scavenge N
  - Currently no N credit in WI for rye & brassica’s
  - Current WI data indicates N taken up by these crops is used in decomposition of their biomass and/or delayed in release
  - More testing needed to draw conclusive N credit recommendation

Cover Crop Nitrate Traps

- Grass crops that establish quickly:
  - Winter rye, oats, barley, Italian rye, sorghum-sudan
- Brassicas and legumes will also take up N, but do not establish as quickly
- Oats, sorghum-sudan, barley and Italian rye (most times) winter kill in WI.
- Winter rye will re-grow in spring
  - Advantage to N uptake and soil health parameters
  - May be easiest cover crop to establish in our area
  - Downside: needs to be terminated before next crop, may cause moisture and nutrient stress for next crop